AD NUMBER
AD009338
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FROM: **confidential**
LIMITATION CHANGES
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AUTHORITY
31 Dec 1964, DoDD 5200.10; DNA ltr, 15 Mar 1977

AD _____

SECURITY INFORMATION

Lab. Project 5046-3, Part 26
Final Report
NS 081-001

AW-7

MATERIAL LABORATORY
NEW YORK NAVAL SHIPYARD
BROOKLYN 1, N. Y.

TECHNICAL REPORT

CRITICAL THERMAL ENERGIES of ALUMINIZED ASBESTOS CLOTH

Submitted by

THE WRIGHT AIR DEVELOPMENT CENTER

L. Banet and J. Bracciaventi

Lab. Project 5046-3, Part 26
Final Report
NS 081-001
Technical Objective AW-7
AFSWP-380
1 December, 1952

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ABSTRACT

For the purpose of evaluating the resistance of materials to the thermal radiation of atomic explosions, the critical thermal energies and the apparent transmission of radiation of an aluminized asbestos cloth were determined. The cloth was evaluated by exposing it to the Material Laboratory carbon-arc source of thermal radiation at a rate of 85 cal/cm^2 sec and examining the consequent damage to the cloth. The amount of radiation transferred through the cloth to a backing was determined through the use of heat-sensitive papers mounted with a 1/16-inch air gap behind the cloth. The methods of exposing the materials, of determining critical energies and of measuring the apparent transmissions are indicated. It was found that charring occurred at 2.5 cal/cm^2, that flames formed at 4.4 cal/cm^2, and that destruction occurred at 44 cal/cm^2. While the apparent transmission of the cloth was only 1.3 per cent at a radiant exposure of 4.4 cal/cm^2, it increased to a value of 13 per cent at a radiant exposure of 46 cal/cm^2.

CONTENTS

CONFIDENTIAL

Lab. Project 5046-3, Part 26

Final Report

Ref: (a) WADC ltr WCRTT-2/OJR/jp of 23 Jul 1952
(b) COMNYKNAVSHIPYD ltr C-S99/L5, Ser C-960-92, of 14 Mar 1950
(c) BUSHIPS restr spdltr S99-(0)(348), Ser 348-75, of 6 Apr 1950

Encl: (1) Critical Thermal Energies of Metallized Asbestos Cloth
(2) Apparent Transmission of Radiation Through Metallized Asbestos Cloth

AUTHORITY

1. This investigation, requested under reference (a), has been conducted as part of the general Thermal Radiation program proposed by reference (b) and formally authorized by reference (c). The Thermal Radiation program is under the Supervision of the Armed Forces Special Weapons Project.

INTRODUCTION

2. As part of its general program on the effects of the thermal radiation of atomic explosions on materials, the Material Laboratory is evaluating the characteristics, under exposure to thermal radiation, of the various materials under the cognizance of the several agencies of the Department of Defense. As data become available, these findings are published. In this report, the critical thermal energies of an aluminized asbestos cloth submitted by the Materials Laboratory, Wright Air Development Center, are indicated.

3. The asbestos cloth, 10 oz/yd^2, consisted of 14 per cent cotton, 29 per cent fiberglas, and 57 per cent asbestos.

EQUIPMENT AND METHODS OF EXPOSURE

4. The critical thermal energies of the asbestos cloths were determined by exposing them to the Material Laboratory carbon-arc source of thermal radiation. The source[1] consists of an 11-mm carbon arc, mounted at the focus of a parabolic mirror which collimates the emitted energy; a second mirror, which is mounted coaxially at a distance of 12 feet from the collimator, condenses the radiation to its focus. Gradations of thermal damage were obtained by varying the effective exposure time through accelerating a 1x8-inch sample which moves transversely through the focus. The rate of application of energy during all exposures was 85 cal/cm^2 sec over a central area 2 mm wide.

5. The cloth samples were mounted with a 1/16-inch air gap over black carbon paper or vesicant gas-detector (M6) paper. By noting the effects of each exposure on the indicator paper, an estimate of the radiation-transmittance of the cloth was obtained.[2] In this determination, the energies incident on the asbestos cloth which produce certain effects on the indicator papers were measured, as well as the total source energy required to produce the same effects directly. The apparent transmittance is defined as the ratio of these two values. The protective value of the metallized asbestos cloth in a clothing assembly was not investigated in this study.

RESULTS

6. The critical thermal energies were defined as those which produce certain characteristic, reproducible effects on the materials, such as charring, flaming or destruction. The critical energies of the asbestos cloth are indicated in Enclosure (1). The energies on the cloth surface required to produce certain observable effects on the indicator paper are listed in Enclosure (2).

7. It may be noted that the laboratory exposures have been made under highly controlled conditions and, as a rule, give results which can be reproduced very well. However, for several reasons, the data of Enclosures (1) and (2) should be used with caution. The effects to be observed on material surfaces remain unchanged over a considerable range of exposures. Since the surface effects are not sufficiently gradated for refined evaluations, only the initial stages have been recorded. The effects are influenced by such factors as mounting, geometry of material and of exposure, weathering and the moisture content at the time of exposure. Differences in density, absorptivity, chemical compesition and particle size are responsible for the variations in effects which may be observed from area to area on the same material. Liquids and gases form during exposure to thermal radiation, even in a period of less than one second, thereby affecting the amount of thermal radiation incident on, and absorbed by the surface. It was observed during the exposures that large soft soot particles were released by the cloth after flaming started and that the quantity of soot increased considerably with an increase in the time of exposure.

SUMMARY

8. The results of this investigation may be summarized as follows:

   a. Upon exposure to the carbon-arc source with an irradiance of 85 cal/cm^2 sec, the aluminized asbestos cloth suffers an initial surface char at 2.5 cal/cm^2.

   b. Under the same conditions, the cloth material flames during exposure to 4.4 cal/cm^2 and its back surface blackens at 6.5 cal/cm^2. Destruction occurs at 44 cal/cm^2.

   c. The apparent transmission values, although small for low-radiant exposures, increase with the radiant exposure. These values vary from 1.3 per cent at 4.4 cal/cm^2, 3.7 per cent at 21 cal/cm^2, to 13 per cent at 46 cal/cm^2.

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Approved:

H. T. Koonce

H. T. KOONCE, CAPTAIN, USN
The Director

CRITICAL THERMAL ENERGIES

of

ASBESTOS CLOTH

Submitted by

THE MATERIAL LABORATORY,
WRIGHT AIR DEVELOPMENT CENTER

Material	Description of Effect	Critical Energy (cal/cm^2)
Aluminized asbestos cloth, 10 oz., 14% cotton, 29% fiberglass, 57% asbestos.	Surface charring	2.5
	Flame formation during exposure	4.4
	Blackening of back surface	6.5
	Destruction	44

APPARENT TRANSMISSION OF RADIATION THROUGH ASBESTOS CLOTH OF THE MATERIAL LABORATORY, WRIGHT AIR DEVELOPMENT CENTER

Material	Description of Effect	Energy Required (cal/cm^2)	Total Incident Energy On Cloth (cal/cm^2)	Apparent Transmission (Per Cent)
Asbestos cloth 10 oz.	Dulling of carbon paper surface	0.059	4.4	1.3
	Destruction of carbon paper	0.78	21	3.7
	Paint distillation of vesicant paper	5.9	46	13

3 September 1952

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